
U.S. Army Research Institute
for the Behavioral and Social Sciences

Research Report 1562

# Training Effectiveness Evaluation of the Squad Engagement Training System (SETS)

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June 1990

# U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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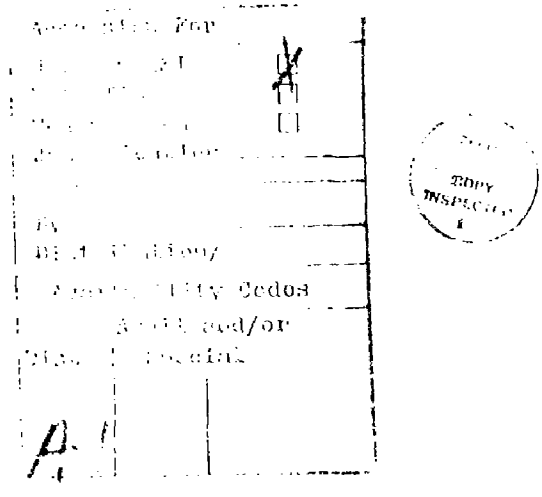

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UNCLASSIFIED
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# REPORT DOCUMENTATION PAGE

Form Approved
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| | |
|---|---|
| 1a REPORT SECURITY CLASSIFICATION<br>Unclassified | 1b RESTRICTIVE MARKINGS<br>-- |
| 2a SECURITY CLASSIFICATION AUTHORITY<br>-- | 3 DISTRIBUTION/AVAILABILITY OF REPORT<br>Approved for public release; distribution is unlimited. |
| 2b DECLASSIFICATION/DOWNGRADING SCHEDULE<br>-- | |
| 4 PERFORMING ORGANIZATION REPORT NUMBER(S)<br>-- | 5 MONITORING ORGANIZATION REPORT NUMBER(S)<br>ARI Research Report 1562 |

| | | |
|---|---|---|
| 6a NAME OF PERFORMING ORGANIZATION<br>CAE-Link Corporation<br>Link Training Services Division | 6b OFFICE SYMBOL (If applicable)<br>-- | 7a NAME OF MONITORING ORGANIZATION<br>U.S. Army Research Institute<br>Boise Element |
| 6c ADDRESS (City, State, and ZIP Code)<br>209 Madison Street<br>Alexandria, VA 22314 | | 7b ADDRESS (City, State, and ZIP Code)<br>1910 University Drive<br>Boise, ID 83725-1140 |
| 8a NAME OF FUNDING/SPONSORING ORGANIZATION<br>U.S. Army Research Institute for the Behavioral and Social Sciences | 8b OFFICE SYMBOL (If applicable)<br>PERI-I | 9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER<br>DABT60-87-C-2776 |
| 8c ADDRESS (City, State, and ZIP Code)<br>5001 Eisenhower Avenue<br>Alexandria, VA 22333-5600 | | 10 SOURCE OF FUNDING NUMBERS<br>PROGRAM ELEMENT NO. 63007A; PROJECT NO. 795; TASK NO. 3308; WORK UNIT ACCESSION NO. X05 |

11 TITLE (Include Security Classification)
Training Effectiveness Evaluation of the Squad Engagement Training System (SETS)

12. PERSONAL AUTHOR(S) Eisley, Mark E. (CAE-Link Corp.); Hagman, Joseph D. (ARI); Ashworth, Robert L. (ARI); and Viner, Myron P. (CAE-Link Corp.)

| 13a. TYPE OF REPORT | 13b TIME COVERED | 14. DATE OF REPORT (Year, Month, Day) | 15 PAGE COUNT |
|---|---|---|---|
| Final | FROM 89/09 TO 90/05 | 1990, June | |

16. SUPPLEMENTARY NOTATION Funding provided by National Guard Bureau (NGB-ARO), 111 S. George Mason Drive, Arlington, VA 22204, and by Training Development and Analysis Directorate (TDAT), U.S. Army Training and Doctrine Command (TRADOC)

| 17. COSATI CODES | | |
|---|---|---|
| FIELD | GROUP | SUB-GROUP |
| 05 | 06 | |
| 19 | 06 | |

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Reserve component; Marksmanship; Training devices; Squad-level training; Tactical training; Transfer of training

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

For this report, researchers worked to determine (a) whether the Squad Engagement Training System (SETS) can be used to enhance squad-level tactical proficiency, (b) the relationship between SETS-based and range-based marksmanship qualification scores, and (c) soldier perceptions of SETS-based training. Nine infantry and nine support squads from the Oregon Army National Guard (ORARNG) were assigned randomly to experimental and control groups. Experimental group squads received 2 hours of SETS-based training that included firing for record on a simulated 25-m alternate qualification course and participating in two tactical training exercises conducted as part of a simulated company defense. They then proceeded to zero their weapons, participate in two tactical evaluation exercises on a squad live-fire range (SLFR), fire for record on a 25-m alternate qualification course, and fill out a questionnaire pertaining to their SETS-based training experience. Control group squads did not receive initial SETS-based training, but proceeded directly to zero their weapons, complete the SLFR tactical exercises, and fire for record. Squad leaders in both groups were
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| 20 DISTRIBUTION/AVAILABILITY OF ABSTRACT<br>☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS | 21 ABSTRACT SECURITY CLASSIFICATION<br>Unclassified |
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DD Form 1473, JUN 86 *Previous editions are obsolete*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ARI Research Report 1562

19. ABSTRACT (Continued)

evaluated at the SLFR on 27 subtasks selected from the tactical tasks of Prepare for Combat, Defend, and Consolidate/Reorganize. Overall squad performance on the SLFR was measured in terms of fire distribution (i.e., the number of targets hit/the number of rounds fired).

With respect to tactics, squad leaders and squad members performed better on the SLFR if they had prior SETS-based training, i.e., positive transfer. Tactical subtask scores for experimental group squad leaders improved during SETS-based training and carried over to the SLFR, where experimental group squad leaders outperformed control group squad leaders, with differences particularly evident among the leaders of support squads. Squad members also displayed better fire distribution scores on the SLFR after SETS-based training. This was especially true for support squads in the experimental group. The correlation between SETS-based and range-based marksmanship qualification scores was statistically significant but not high enough to support accurate prediction of range-based scores from SETS-based scores. Lastly, soldiers indicated that they enjoyed training on SETS and felt that it would be a valuable device for home-station training.

These results attest to SETS' potential to support the training of stationary squad-level defensive tactical skills required of Active and Reserve Component units. In particular, SETS could provide Reserve Component soldiers with an opportunity for the kind of realistic engagement of opposing forces (OPFOR) that is necessary for training and maintaining small-unit defensive tactics but difficult to furnish at home station. In regard to marksmanship, the results of this evaluation would not support a recommendation to use SETS-based scores in place of range-based scores for purposes of record-fire qualification.

Research Report 1562

# Training Effectiveness Evaluation of the Squad Engagement Training System (SETS)


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**June 1990**


Army Project Number
2Q263007A795

Training and Simulation

This report examines tactical training effectiveness of the Squad Engagement Training System (SETS), an indoor device designed to support Reserve Component (RC) training of individual soldier marksmanship and fundamental squad-level tactical engagement skills. Results suggest that SETS-based training can enhance defensive tactical proficiency at the squad level, as measured by squad live-fire range performance. This positive finding, coupled with SETS' indoor design, underscores the real potential for SETS to support effective home-station tactical training, and thereby, help to overcome time, equipment, and range constraints in the RC training environment.

This research was conducted by the Training Technology Field Activity, Gowen Field (TTFA-GF), whose mission is to improve the effectiveness and efficiency of RC training through use of the latest in training technology. The research task supporting this mission is entitled "Application of Training to Meet RC Training Needs" and is organized under the "Training for Combat Effectiveness" program area.

The National Guard Bureau (NGB) and U.S. Army Training and Doctrine Command (TRADOC) sponsored this project under a Memorandum of Understanding, signed 12 June 1985, establishing the TTFA-GF. Project results have been presented to Chief, Organization and Training Division, Training Support and Management Branch, NGB; Chief, Training Division, Office of the Chief, Army Reserve (OCAR); Director, Training Development and Analysis Directorate (TDAD); TRADOC; and Director, Training and Doctrine, U.S. Army Infantry School (USAIS).

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ACKNOWLEDGMENTS

We thank the Oregon Army National Guard for outstanding support provided during the data collection phase of this evaluation. Special appreciation is extended to LTC William R. Mansfield, who provided resources and top-notch personnel to "make it happen"; SFC Thomas J. Wenner, who provided invaluable support to project planning by sharing his expertise on range operations and coordinating key administrative and logistical requirements; and SFC David R. Haugh, who was totally responsive to our many requests for assistance in his role as liaison to the U.S. Army Research Institute, Boise, and who organized and served as noncommissioned-officer-in-charge of a 50-soldier element charged with providing all administrative and logistical support critical to the success of the data collection effort.

TRAINING EFFECTIVENESS EVALUATION OF THE SQUAD ENGAGEMENT TRAINING SYSTEM (SETS)

## EXECUTIVE SUMMARY


Requirement:

Researchers worked to determine (a) the potential for SETS-based training to enhance squad-level tactical proficiency, (b) the relationship between SETS-based and range-based marksmanship qualification scores, and (c) soldier perceptions of SETS-based training.

Procedure:

Nine infantry and nine support squads from the Oregon Army National Guard (ORARNG) were assigned randomly to each of two groups (experimental and control). Experimental group squads received 2 hours of indoor SETS-based training that included firing for record on a simulated 25-m alternate qualification course and participating in two tactical training exercises conducted as part of a simulated company defense. They then proceeded outside to zero their weapons, participate in two tactical evaluation exercises on a squad live-fire range (SLFR), fire for record on the 25-m alternate qualification course, and fill out a questionnaire pertaining to their SETS-based training, control group squads proceeded directly to zero their weapons, complete the SLFR tactical exercises, and fire for record.

Squad leaders in both groups were evaluated at the SLFR on 27 subtasks selected from the tactical tasks of Prepare for Combat, Defend, and Consolidate/Reorganize. Overall squad performance on the SLFR was measured in terms of bullet strike efficiency (the number of target holes/the number of rounds fired) and targets hit efficiency (the number of separate targets hit/the number of rounds fired), with the latter reflecting degree of fire distribution.

Findings:

With respect to tactics, squad leaders and squad members performed better on the SLFR as a result of prior SETS-based training, i.e., positive transfer. In particular, tactical subtask scores for experimental group squad leaders improved

during SETS-based training carried over to the SLFR, where experimental group squad leaders outperformed control group squad leaders, with the difference particularly evident among the leaders of support squads. Squad members also displayed better fire distribution scores on the SLFR as a result of prior SETS-based training. This advantage was especially found for support squads in the experimental group. The correlation between SETS-based and range-based marksmanship qualification scores was significant but not high enough to support accurate prediction of range-based scores from SETS-based scores ($r = .33$). Lastly, soldiers indicated that they enjoyed training on SETS and felt that it would be a valuable device for home-station training.

Utilization of Findings:

These results attest to SETS' potential to support the training of stationary squad-level defensive tactical skills required of Active and Reserve Component units. SETS could provide Reserve Component soldiers, for example, with an opportunity for the kind of realistic engagement of opposing forces (OPFOR) that is vital for training and maintaining small-unit defensive tactics but difficult to furnish at home station. In regard to marksmanship, the results of this evaluation would not support a recommendation to use SETS-based scores in place of range-based scores for purposes of record-fire qualification.

TRAINING EFFECTIVENESS EVALUATION OF THE SQUAD ENGAGEMENT TRAINING SYSTEM (SETS)

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# TRAINING EFFECTIVENESS EVALUATION OF THE SQUAD ENGAGEMENT TRAINING SYSTEM (SETS)

## Background

Total Force Policy requires the Army's Reserve Components (RC), i.e., the Army National Guard (ARNG) and U.S. Army Reserve (USAR), to attain and maintain readiness levels comparable to those of the Active Component (AC). To do so, the RC must meet formidable training challenges stemming from real constraints on time, mission-essential equipment, and access to range or maneuver areas.

Because of these constraints, most RC training is confined to the local armory or reserve center (i.e., home station) where it is difficult to provide the kind and amount of realistic training necessary to ensure required levels of individual and collective skill proficiency. Even fundamental weapons training suffers because soldiers have limited opportunities to develop/sustain marksmanship skills, engage realistic targets, and practice the kind of tactics needed to succeed on the modern battlefield. RC combat arms, combat support, and combat service support units need the capability of training to these ends at home station.

To meet this need, the National Guard Bureau (NGB) is seeking to use technology in the form of simulators and training devices. One such device is the Squad Engagement Training System (SETS), a multipurpose device developed by Firearms Training Systems, Inc., to support the indoor training of both individual rifle marksmanship and squad-level tactics.

Depicted in Figure 1, SETS uses a combination of videodisc-based, synchronized wide-screen image projection, laser hit-detection, and microcomputer technology to furnish a variety of target arrays, courses of fire, and tactical engagement exercises. Once an exercise is selected, SETS displays proportionately correct targets on a 2.44 m (8') high x 9.14 m (30') wide screen. Targets are engaged with laser-fitted, demilitarized weapons (M16A2 rifle, M60 machinegun, and M203 grenade launcher) that simulate the recoil (M16A2 rifle and M60 machinegun only) and sound of real weapons firing live ammunition. Diagnostic training analysis is aided by SETS' ability to present immediate or delayed on-screen feedback, in real time or slow motion, of all training activities as well as a paper printout of individual soldier and squad-level performance measures.

## Marksmanship Training

To support individual marksmanship training, SETS contains a series of exercises, e.g., Aiming, Target Box, Grouping [see

U.S. Army Field Manual (FM) 23-9 for a description (Department of the Army, 1989)], designed to build and sustain fundamental shooting techniques needed for hitting stationary and moving targets. Results of recent research (e.g., White, Carson, Wynkoop, Cameron, & Butzin, 1989) with Air Force security police attest to the positive training value of these exercises, as shown on a SETS predecessor called the Advanced Individual Combat Arms Trainer (AICAT). Besides formal training exercises, SETS also contains simulated basic and advanced rifle marksmanship ranges on which soldiers can develop and test their shooting proficiency.

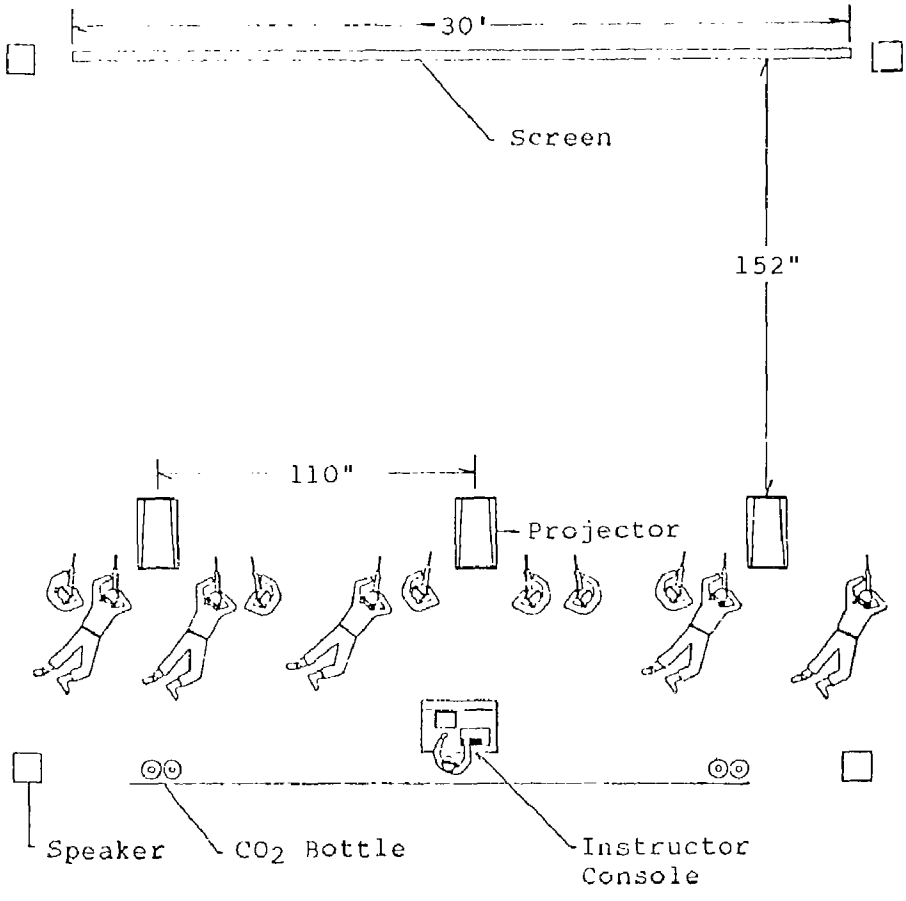


Figure 1. SETS configuration.

## Tactical Training

To support tactical training, SETS contains 16 different exercises, or scenarios, wherein a squad can conduct stationary offensive (e.g., day/night linear ambush) or defensive (e.g.,

squad defense) operations against opposing forces (OPFOR). The SETS instructor can "set up" each tactical exercise for the participating squad by describing the situation and establishing the conditions and standards for each task to be trained. Most of the exercises can then be initiated by issuing a combat order. Acting as the platoon leader, for example, the SETS instructor might describe the tactical situation and issue the platoon order [e.g., operation order (OPORD) or fragmentary order (FRAGO)] to the squad leader for conduct of a defensive operation within the context of a SETS exercise.

Results of recent tactical engagement simulation research (Hart & Sulzen, 1988; Sulzen, 1987; Sulzen, Whitmarsh, & Hart, 1989) indicate that (a) repetitive training on simulated combat exercises significantly increases unit odds of winning in battle, (b) repetition benefits increase as unit size decreases from platoon to squad, (c) training of both unit leaders as well as unit members is essential, and (d) training on tasks performed during enemy contact is critical for success.

Given that SETS is designed for repetitive use, can incorporate squad leader and squad member training, provides a wide variety of tactical exercises involving OPFOR contact, and can be set up indoors, the potential for effective and convenient squad-level tactical training for RC soldiers may exist at home station like never before. The present research examines the validity of this claim.

## Purpose

In general, a transfer-of-training research design was used to (a) determine if SETS-based training can improve squad-level tactical proficiency, (b) examine the relationship between SETS-based and live-fire marksmanship qualification scores, and (c) collect RC soldier opinions about the value of SETS-based training. Such information is needed by the RC to identify potential SETS-based training benefits and soldier acceptance, determine if and how the device should be used, and decide whether future development and/or fielding of it is justified.

## Method

### Subjects

Thirty-six squads of 9 soldiers each, from the 41st Infantry Brigade (Separate) of the Oregon Army National Guard (ORARNG) traveled to Camp Rilea, Oregon, to participate in the evaluation. Eighteen squads came from the 1st Battalion, 162nd Infantry, and eighteen came from the 141st Support Battalion. Hereafter, these two squad types will be referred to as infantry and support.

Design and Procedure

Nine infantry and 9 support squads were assigned randomly to each of two groups (experimental and control). As shown in Figure 2, experimental group squads first received indoor SETS-based training and then proceeded outside to zero their weapons, participate in two squad live-fire tactical evaluation exercises, complete a record-fire qualification course, and fill out a questionnaire pertaining to their SETS-based training experience. Control group squads received no initial SETS-based training. Instead, they proceeded directly outside to zero their weapons, participate in the squad live-fire tactical evaluation exercises, and fire for record. They were then given complementary SETS-based training just prior to filling out the questionnaire. This training was conducted only to obtain marksmanship qualification scores and to ensure that all squads had the same SETS experience before responding to the questionnaire. Thus, control group squad tactical performance on SETS was not analyzed.

| GROUP | SETS TRAINING | WEAPON ZERO | TACTICAL EVALUATION | RECORD FIRE | SETS TRAINING | QUESTION-NAIRE |
|---|---|---|---|---|---|---|
| EXPERIMENTAL | YES | YES | YES | YES | NO | YES |
| CONTROL | NO | YES | YES | YES | YES | YES |

Figure 2. Treatment design.

SETS-based training. Squads received about 2 hr of SETS-based training. During this time, they (1) were given an orientation briefing on what to expect during the training session and how to operate SETS' demilitarized weapons (i.e., M16A2 rifles, M60 machinegun, and M203 grenade launcher), (2) zeroed their SETS weapons (M16A2 rifle and M60 machinegun only), (3) practiced marksmanship, and (4) participated in two tactical training exercises.

During marksmanship practice, soldiers shot for record on a simulated 25-m alternate qualification course in accordance with procedures prescribed in U.S. Army FM 23-9 (Department of the Army, 1989). Simulated record fire was followed by on-screen feedback showing the number and location of all shots fired, accompanied by a marksmanship score (i.e., 0-40) and associated rating (i.e., unqualified, marksman, sharpshooter, expert) for each soldier. They then fired 50 shots at stationary and moving targets previously video recorded at the Malone 18 Range, Fort Benning, Georgia. Simulated Malone 18 Range firing was replayed in slow-motion to reveal both the sequence and location of shots fired by each weapon/soldier. The replay was followed by a

summary feedback screen showing the number of shots fired and target hits by each soldier/weapon.

Tactical training involved two exercises conducted within the context of a company defense. Each exercise was identical except for the projected terrain and associated OPFOR fire and movement. Squad leaders received a tactical situation overview and platoon FRAGO (see Appendix A) from the SETS instructor who acted as the platoon leader. Squad leaders then had to assess the terrain shown on the screen, assign sectors of fire to squad members, and order preparation for the first (or second) of two defensive exercises.

Squads consisted of 9 members: one M60 machinegunner, one M60 assistant machinegunner, one M203 grenadier, and six M16A2 riflemen, to include the squad leader. For each exercise, riflemen were allocated 60 rounds (three 20-round magazines) of simulated 5.56 mm ammunition, grenadiers were allocated six simulated 40 mm grenades, and machinegunners were allocated 90 rounds of 7.62 mm (tracer: ball ratio of 1:4) ammunition. The machinegun was bipod supported and all squad members fired from a prone supported position.

Squad leaders were evaluated (GO/NOGO basis) on their performance of 27 subtasks (Appendix B) extracted from Army Training and Evaluation Program (ARTEP) 7-8-Mission Training Plan (MTP) under the three tasks of Prepare for Combat, Defend, and Consolidate/Reorganize (Department of the Army, 1988). The same evaluator observed and rated all 36 participating squads. Subtasks that could not physically be performed within the context of the SETS-based exercises, such as posting security, were "talked through" by the squad leader and evaluated accordingly by the SETS instructor. Upon exercise completion, the squad leader was given feedback on the number and kind of subtasks missed, and then the entire squad was shown a slow-motion replay of the action that included by-soldier summary feedback on the number, sequence, and location of shots fired, total hits, total hits per sector, and the total number of different targets hit.

Tactical evaluation. SETS' ability to support tactical training was evaluated within the context of two defensive exercises conducted on a squad live-fire range (SLFR). In general, these exercises were designed to be as similar as possible to those conducted on SETS so as to maximize the probability of obtaining positive transfer from the device to the range. One at a time, squads were moved to a holding area to be briefed on range safety and the administrative requirements of the evaluation. The squad leader then moved his squad to an assembly area and reported to the platoon leader, who was portrayed by the squad evaluator. The squad leader was then taken on a reconnaissance of the defensive position by the platoon leader. There, the squad leader received the platoon

FRAGO and a rough terrain map on which to prepare a sector sketch. He was then told to return to his squad and prepare to defend. The squad then moved tactically to its defensive position.

Each exercise lasted 1 min. During this time, 60 pop-up, E-type silhouette targets were presented in 2 sequences of 30 targets each. Each 30-target sequence was presented in banks of 5 targets each in a left-to-right, back-to-front order (i.e., Banks A-F) so as to represent OPFOR squads conducting fire and movement. Figure 3 shows each target position and 5-target bank. Targets were programmed to drop when hit or after a specified time limit (10 s for Banks A and B, 7 s for Banks C and D, and 5 s for Banks E and F), as suggested by Infantry Squad (1984).

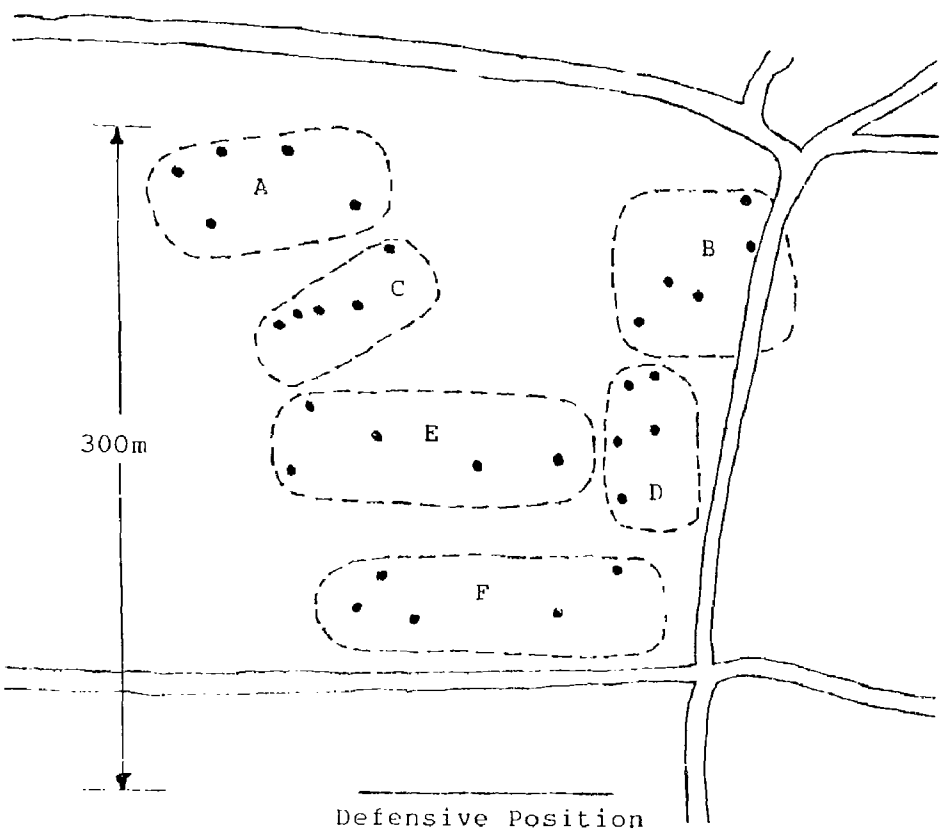


Figure 3. SLFR target layout. (• = targets; A-F = banks)

All weapons were fired in the first exercise, whereas all but the M60 machinegun were fired in the second exercise in an attempt to identify squad performance with and without the machinegun's contribution. For each exercise, riflemen were given 60 rounds (three 20-round magazines) of 5.56 mm

ammunition, the grenadier was given three 40 mm target practice (TP) rounds, and the M60 machinegunner was given 90 rounds of 7.62 mm (tracer: ball ratio of 1:4) ammunition (first exercise only). The machinegun was bipod supported and all squad members fired from a prone supported position.

Collective squad performance was evaluated on the amount of ammunition expended, the number of bullet strikes (i.e., target holes), and the number of targets hit. The latter two measures were not identical because many targets were hit more than once before they dropped out of sight. Squad leader performance was evaluated only during the first of the two SLFR exercises and was measured in terms of the same 27 subtasks covered during SETS-based training (see Appendix B.) The same evaluator observed and rated all 36 participating squads. This evaluator was not told which squads were experimental and which were control.

### Record Fire

After tactical evaluation, each squad member fired for record on the 25-m alternate qualification course. The range support cadre, furnished by the ORARNG, was responsible for course administration and scoring in accordance with guidelines set forth in U.S. Army FM 23-9 (Department of the Army, 1989).

### Questionnaire Administration

As a final step in the SETS evaluation procedure, squad members filled out a questionnaire (see Appendix C) that asked for general demographic information along with soldier opinions about the perceived value of SETS-based training. Experimental group squads completed the entire questionnaire after firing for record, whereas control group squads answered the demographic questions (Part A) after record fire and the SETS-related questions (Part B) after complementary SETS-based training.

## Results

### Marksmanship Performance

Analysis of individual soldier marksmanship performance revealed that SETS-based alternate course qualification scores averaged a significant, $t(269) = 7.27$, 3.5 points higher than range-based qualification scores. Unless stated otherwise, the rejection region for all analyses was .05. The correlation between SETS- and range-based qualification scores ($r = .33$) also was significant. It was not high enough, however, to support accurate prediction of range-based scores from SETS-based scores, and therefore, was not of much practical value. Lastly, a 2 x 2 between-subjects factorial analysis of variance

revealed no differences in range-based qualification scores as a function of group (experimental, control) or unit type (infantry, support) with the overall average number of hits equal to 28.41 out of a possible 40. Because marksmanship skills were practiced, and not trained, on SETS, no difference between experimental and control group squad marksmanship scores was expected. With all squads demonstrating about the same level of proficiency, any SLFR performance differences found hereafter cannot be attributed to marksmanship.

## Tactical Performance

Squad leader. Squad leader tactical performance on SETS and the SLFR was scored in terms of the 27 subtasks selected under the tasks of Prepare for Combat, Defend, and Consolidate/Reorganize. As shown in Table 1, the performance of experimental group squad leaders improved across the two

Table 1

Average Number of Tactical Subtasks Performed Correctly by Each Squad Leader on SETS and SLFR

| | | SETS | | |
|---|---|---|---|---|
| Group | Unit | Exercise 1 | Exercise 2 | SLFR |
| Experimental | | 17.2 | 23.4 | 20.6 |
| | Infantry | 22.8 | 24.8 | 20.4 |
| | Support | 11.7 | 22.1 | 20.8 |
| Control | | - | - | 15.3 |
| | Infantry | - | - | 17.9 |
| | Support | - | - | 12.8 |

SETS tactical exercises with an average of 6.2 more subtasks performed correctly on Exercise 2 than on Exercise 1, $F(1,34) = 30.54$. This increase, however, was greater for support squad leaders than for infantry squad leaders, as indicated by a significant Unit x Exercise interaction, $F(1,34) = 11.68$. This difference can be attributed to the relatively low initial level of performance demonstrated on Exercise 1 by support squad leaders. Compared to infantry squad leaders, support squad leaders were in a better position to learn from the subtasks performed within the context of SETS-based defensive tactical exercises. In contrast, infantry squad leaders had less to learn from the SETS-based exercises as demonstrated by the relatively high subtask score obtained on Exercise 1.

The performance of experimental and control group squad leaders was compared to determine whether SETS-based training influenced performance on the SLFR. In general, SETS-based training improved (i.e., transferred positively to) subsequent SLFR performance. A Group (experimental, control) x Unit (infantry, support) between-subjects factorial ANOVA performed on squad leader tactical scores revealed a significant main effect of group, $F(1,32) = 19.56$, and Group x Unit interaction, $F(1,32) = 5.20$. Scores shown in the SLFR column of Table 1, indicate that without SETS-based training (i.e., control group) infantry squad leaders performed better than support squad leaders as might be expected, but with SETS-based training (i.e., experimental group) this difference was eliminated.

Squad. Only M16 rifle performance was analyzed because the number of targets hit with the M60 machinegun and M203 grenade launcher was negligible. A preliminary Group (experimental, control) x Unit (infantry, support) between-subjects ANOVA performed on the number of rounds fired during each SLFR exercise, revealed that infantry squads fired significantly more rounds than support squads, $F(1,32) = 10.77$. Thus, to eliminate the potential effect of this difference on subsequent comparisons, and thereby, obtain a measure of squad proficiency uncontaminated by the number of rounds fired, squad performance was analyzed in terms of two efficiency measures: the total number of bullet holes in all targets combined divided by the number of rounds fired (i.e., bullet strike efficiency); the number of separate targets hit divided by the number of rounds fired (i.e., targets hit efficiency).

A Group x Unit between-subjects ANOVA performed on bullet strike efficiency scores for Exercise 1 revealed only a main effect of unit with infantry squads (35% efficiency) outperforming support squads (20% efficiency), $F(1,32) = 13.07$, $p < .001$. For Exercise 2 the main effect of group, $F(1,32) = 3.30$, tended to favor experimental (12% efficiency) over control (8% efficiency) squads but failed to reach significance, with $p < .10$.

The ANOVA performed on targets hit efficiency scores revealed a significant main effect of group for Exercise 2 [$F(1,32) = 11.26$, $p < .01$] and overall performance [$F(1,32) = 9.67$, $p < .01$], and a marginally significant effect for Exercise 1, $F(1,32 = 3.36$, $p < .08$. In each case, experimental squads outperformed control squads. Means for these results are shown in Table 2. Of particular interest was the significant Group x Unit interaction found for Exercise 1, $F(1,32) = 5.89$, $p < .05$. As shown in Table 2, experimental support squads outperformed control support squads but no corresponding difference was found for infantry squads on this exercise.

Relationship between squad and squad leader SLFR performance. Significant correlations were found between squad

and squad leader performance on the SLFR. As shown in Table 3, the strongest relationships occurred for Exercise 1 in regard to targets hit efficiency. That is, better squad leaders were associated with squads that hit a greater number of different targets overall and during the first SLFR exercise. This relationship would be predicted given that squad leaders presumably have more control over fire distribution than bullet strike location.

Table 2

Means by Group and Unit Type for SLFR Targets Hit Efficiency

| | Group | | |
|---|---|---|---|
| Unit Type | Experimental | Control | Total |
| | Overall | | |
| Infantry | 0.113 | 0.079 | 0.096 |
| Support | 0.121 | 0.071 | 0.096 |
| Total | 0.117 | 0.075 | 0.096 |
| | Exercise 1 | | |
| Infantry | 0.143 | 0.155 | 0.149 |
| Support | 0.175 | 0.088 | 0.131 |
| Total | 0.159 | 0.121 | 0.140 |
| | Exercise 2 | | |
| Infantry | 0.101 | 0.058 | 0.079 |
| Support | 0.104 | 0.063 | 0.084 |
| Total | 0.102 | 0.061 | 0.081 |

Soldiers' Opinions of SETS

Soldier responses to SETS-related questionnaire items were generally positive. As shown in Table 4, both infantry and support soldiers said that they enjoyed training with SETS and strongly agreed that SETS would make a valuable home-station (armory) device for training infantry skills. Soldiers also tended to agree that SETS training helped (experimental group) or would have helped (control group) them personally perform

Table 3

Correlations Between Squad Leader Tactical Performance and SLFR Efficiency Scores

| Efficiency Score | Squad Leader Tactical Performance |
|---|---|
| Bullet strike | |
| Overall | .16 |
| Exercise 1 | .29* |
| Exercise 2 | .02 |
| Targets hit | |
| Overall | .35* |
| Exercise 1 | .38* |
| Exercise 2 | .28 |

Note. $n = 36$.
*$p < .05$, one-tailed.

Table 4

Average Responses for Questionnaire Items

| | Unit type | | |
|---|---|---|---|
| Questionnaire item | Infantry | Support | Overall |
| SETS would be a valuable home-station device for training infantry skill. | 1.6 | 1.3 | 1.4 |
| I enjoyed training with SETS. | 1.3 | 1.2 | 1.3 |
| SETS training helped[a] me personally perform better on the SLFR. | 2.4 | 2.2 | 2.3 |
| SETS training helped[a] my squad perform better on the SLFR. | 2.4 | 2.1 | 2.3 |

Note. Means given are average responses on Likert scales where 1 = strongly agree, 2 = agree, 3 = medium, 4 = disagree, and 5 = strongly disagree. $n = 207$.

[a]In the case of control group soldiers the statement read, "would have helped."

better on the squad live-fire exercises. They also tended to agree that SETS training helped (experimental group) or would

have helped (control group) their squads perform better on the squad live-fire range exercises.

## Summary and Conclusions

The results of this evaluation reveal that SETS can effectively support the training of stationary squad-level defensive tactics. Squad leader and squad member skills that were learned (relearned) during SETS-based training were found to transfer positively to the SLFR. In particular, the tactical subtask scores for experimental group squad leaders improved during SETS-based training and carried over to the SLFR where experimental group squad leaders were found to outperform control group squad leaders. Although both infantry and support squad leaders from the experimental group benefitted from SETS-based training, the latter were affected more than the former, probably because the specific defensive exercises selected were relatively easy for soldiers with an infantry background.

In regard to squad member performance, squads that received prior SETS-based training (i.e., experimental group) demonstrated superior fire distribution scores (i.e., targets hit efficiency) on the SLFR relative to the scores obtained from squads that did not train on SETS prior to SLFR firing (i.e., control group). Presumably, the prior opportunity to learn and apply appropriate unit fire distribution procedures (based on the concept of overlapping sectors of fire) during SETS-based tactical training exercises was responsible for the subsequent superior fire distribution scores obtained on the SLFR. Although this advantage was found especially for support squads within the experimental group, all soldiers indicated that they enjoyed training on SETS and felt that it would be a valuable device for home-station training.

Statistically significant correlations were found between squad leader tactical performance, i.e., number of subtasks rated GO, and squad member tactical performance, i.e., fire distribution scores (targets hit efficiency) on the SLFR. Although no cause and effect conclusions can be made from correlational data, it seems probable that squad leaders who learned how to properly assign sectors of fire during SETS-based training would also be more effective in applying this skill on the SLFR, and thereby, facilitate overall squad performance.

In regard to marksmanship performance, the correlation between SETS- and range-based qualification s ores was statistically significant but not high enough to support the accurate prediction of range-based scores from SETS-based scores, or for SETS-based qualification scores to be used as substitutes for range-based qualification scores. Given the apparent similarity between the 25-m alternate course fired on SETS and that fired on the range, the reason why a higher

correlation was not found is not readily apparent and must await further research.

Results of the present evaluation attest to SETS' potential to support RC home-station training of basic defensive tactical skills--the kind of tactics that every active and reserve combat, combat support, and combat service support squad should be able to demonstrate. It must be emphasized, however, that SETS-based training is instructor dependent. It is up to an instructor, for example, to develop the overall training context within which to place each tactical exercise, such as was done here through the use of a tactical situation overview and FRAGO. An instructor must also identify the specific tasks/subtasks on which to evaluate a squad leader. Such objectives and protocols are not explicitly available at this time in the SETS software. SETS, however, does provide the unique opportunity for realistic OPFOR contact within the RC home-station training environment, and the variety of precise performance measures required for detailed individual and unit-level critique.

## References


Department of the Army. (1989). M16A1 and M16A2 Rifle Marksmanship (Field Manual No. 23-9). Washington, DC: Headquarters, Department of the Army.

Department of the Army. (1988). Mission training plan for the infantry rifle platoon and squad. (Army Training and Evaluation Program No. 7-8-MTP). Washington, DC: Headquarters, Department of the Army.

Hart, R. J., & Sulzen, R. H. (1988, Winter). Comparing success rates in simulated combat: Intelligent tactics vs. force. Armed Forces & Society, pp. 273-286.

Sulzen, R. H. (1987, May). Winning with tactical engagement simulation. Military Review, pp. 8-19.

Sulzen, R. H., Whitmarsh, P. J., & Hart, R. J. (1989, March). Effects of repetitive training on simulated combat outcomes for rifle squads. Paper presented at the meeting of the American Educational Research Association, San Francisco, CA.

White, C. R., Carson, J. L., Wynkoop, K. R., Cameron, V. M., & Butzin, C. A. (1989). Effectiveness of an advanced individual combat arms trainer (AICAT). Unpublished manuscript, Randolph Air Force Base, TX.

Infantry squad live fire range. (1984, March). Camp Rilea Pamphlet Number 1. Camp Rilea, Oregon.

APPENDIX A

Tactical Situation and Platoon FRAGO

**USE WITH SQUAD LIVE-FIRE RANGE**

**TACTICAL SITUATION OVERVIEW** The Company is in an assembly area preparing for future operations. The platoon leader has just received a FRAGO in which the platoon was given its role in the Company's new mission to establish a blocking position.

**PLATOON FRAGO** The Venceremos Battalion of the Rojas Brigade has unexpectedly begun attacking east with Camp Rilea as its apparent objective. They are at about 85% strength and have crew served automatic weapons and heavy mortars.

Our company will establish a blocking position vic DG 272091 to deny the enemy access to the Camp Rilea area.

___ Platoon will defend from a battle position vic DG 270099

___ Platoon will defend from a battle position vic DG 275083

Our mission is to defend from a battle position vic DG 272091 NLT ____ hours to destroy any enemy forces entering our area.

The platoon will depart the assembly area at ____hours and head directly on an azimuth of 230 degrees for 1900 meters. We'll move out in a travelling formation with ___ Squad leading followed by ___ Squad and then ___ Squad. The squad release point is at DG 274091. We'll occupy our battle position with ___ Squad on the left, ___Squad in the center, and ___ Squad on the right. Each squad will establish one OP. Priority of work is per SOP. ___ and ___ Squads will have MGs attached. Dragons will be with ___ and ___ Squads. Priority of fires is to ___ Platoon. I want your sector sketches ASAP.

There will be an ammo issue on the objective.

I'll be with the ___ Squad during movement and behind the center squad in the defense. Signals will be per SOP.

The time is now _____. Are there any questions?

APPENDIX B

Squad Leader Tactical Tasks

| Tasks | Subtasks |
|---|---|
| Prepare for Combat (14 subtasks) | Receives mission |
| | Completes plan |
| | Includes enemy situation in FRAGO |
| | Includes missions of higher and adjacent units in FRAGO |
| | Includes attachments in FRAGO |
| | Includes mission in FRAGO |
| | Includes concept of the operation in FRAGO |
| | Includes fire support in FRAGO |
| | Includes any coordinating instructions in FRAGO |
| | Includes service support in FRAGO |
| | Includes leader's location in FRAGO |
| | Includes signals in FRAGO |
| | Inspects men and equipment |
| | Quizzes men on mission |
| Defend (9 subtasks) | Prior to occupation, squad halts short of the defensive position (actual) and the Squad Leader posts security (simulated) |
| | Assigns primary positions |
| | Assigns sectors of fire for M60/M16/M203 |
| | Has squad occupy defensive position |
| | Squad Leader/Team Leaders check positions |
| | Has squad engage targets with M60/M16/M203 |
| | Draws a sector sketch with sectors of fire |
| | Issues a fire command to engage targets |
| | Issues subsequent fire commands as necessary |
| Consolidate and reorganize (4 subtasks) | Reestablishes observation post (simulated) |
| | Obtains status of men, equipment and ammo |
| | Supervises redistribution of ammo |
| | Reports status to platoon (simulated) |
| TOTAL (27 subtasks) | |

APPENDIX C

Questionnaires

Squad Code Number ____

Privacy Act Form A

Information requested in this survey is being collected under authority 10 USC, Section 4503 for research purposes only. Identifiers will be used only for administrative and statistical control purposes and will be treated as strictly confidential. Participation is voluntary. Failure to respond to any survey questions will result in no penalty. However, your participation is encouraged so that the information requested is complete and representative.

SETS EVALUATION: PARTICIPANT SURVEY

1. Name _____

2. Rank _____

3. Social Security Number _____

4. Company _____

5. Platoon/Section _____

6. Squad/Detachment _____

7. In what MOS(s) are you qualified (i.e., officially awarded)? _____

8. What is your current Duty MOS _____

9. What is your current Duty Position _____

10. How many total months have you served in this type of Duty Position? (Include both Active and Reserve time if applicable.)

_____ Months

11. Have you fired a qualification course this past year with the:

a) M16 Rifle Yes ____ No ____
If Yes, check ( ) the rating you received.

Expert ____ Sharpshooter ____
Qualified ____ Unqualified ____

b) M60 Machinegun Yes ____ No ____
If Yes, check ( ) the rating you received.

Expert ____ Sharpshooter ____
Qualified ____ Unqualified ____

c) M203 Grenade Launcher Yes ___ No ___
If Yes, check ( ) the rating you received.

Expert _____ Sharpshooter _____
Qualified _____ Unqualified _____

12. What was your job in this weekend's Squad Live-Fire Exercises? Check ( ) one job listed below.

Squad Leader ___ Ass't Squad Leader ___ Team Leader ___
M16A1 Rifleman ___ M60 Machinegunner ___
M203 Grenadier ___ Ass't M60 Machinegunner __

a) If you were the Squad Leader, how many months of previous experience have you had in that position? _____ month(s)

13. How many Squad Live-Fire Exercises have you participated in before this weekend? _____

How many of them have been at Camp Rilea? _____

How many months has it been since your last Squad Live-Fire Exercise at Camp Rilea (If never, check here ____)? _____ month(s)

Circle the answer to the left that indicates how strongly you agree or disagree with each statement.

sa = strongly agree
a = agree
m = medium (neither agree nor disagree)
d = disagree
sd = strongly disagree

sa a m d sd 14. Prior SETS training helped me personally perform better on the Squad Live-Fire Exercises this weekend.

sa a m d sd 15. Prior SETS training helped my squad perform better on the Squad Live-Fire Exercises this weekend.

sa a m d sd 16. SETS would be a valuable home-station (armory) device for training infantry skills.

sa a m d sd 17. I enjoyed training with SETS.

18. How would you change SETS to increase its training potential? _____

_____

_____

_____

Squad Code Number ____

Privacy Act Form B: Part 1

Information requested in this survey is being collected under authority 10 USC, Section 4503 for research purposes only. Identifiers will be used only for administrative and statistical control purposes and will be treated as strictly confidential. Participation is voluntary. Failure to respond to any survey questions will result in no penalty. However, your participation is encouraged so that the information requested is complete and representative.

SETS EVALUATION: PARTICIPANT SURVEY

1. Name _____

2. Rank _____

3. Social Security Number _____

4. Company _____

5. Platoon/Section _____

6. Squad/Detachment _____

7. In what MOS(s) are you qualified (i.e., officially awarded)? _____

8. What is your current Duty MOS _____

9. What is your current Duty Position _____

10. How many total months have you served in this type of Duty Position? (Include both Active and Reserve time if applicable.)

_____ Months

11. Have you fired a qualification course this past year with the:

a) M16 Rifle Yes ____ No ____
If Yes, check ( ) the rating you received.

Expert ____ Sharpshooter ____
Qualified ____ Unqualified ____

b) M60 Machinegun Yes ____ No ____
If Yes, check ( ) the rating you received.

Expert ____ Sharpshooter ____
Qualified ____ Unqualified ____

c) M203 Grenade Launcher Yes ____ No ____.
If Yes, check ( ) the rating you received.

Expert _____ Sharpshooter _____
Qualified _____ Unqualified _____

12. What was your job in this weekend's Squad Live-Fire Exercises? Check ( ) one job listed below.

Squad Leader ___ Ass't Squad Leader ___ Team Leader ___
M16A1 Rifleman ___ M60 Machinegunner ___
M203 Grenadier ___ Ass't M60 Machinegunner ___

a) If you were the Squad Leader, how many months of previous experience have you had in that position? _____ month(s)

13. How many Squad Live-Fire Exercises have you participated in before this weekend? _____

How many of them have been at Camp Rilea? _____

How many months has it been since your last Squad Live-Fire Exercise at Camp Rilea (If never, check here ____)? _____ month(s)

Squad Code Number ____

Privacy Act Form B: Part 2

Information requested in this survey is being collected under authority 10 USC, Section 4503 for research purposes only. Identifiers will be used only for administrative and statistical control purposes and will be treated as strictly confidential. Participation is voluntary. Failure to respond to any survey questions will result in no penalty. However, your participation is encouraged so that the information requested is complete and representative.

## SETS EVALUATION: SUPPLEMENT

1. Name _____

2. Social Security Number _____

Circle the answer to the left that indicates how strongly you agree or disagree with each statement.

sa = strongly agree
a = agree
m = medium (neither agree nor disagree)
d = disagree
sd = strongly disagree

sa a m d sd 14. I would have performed better on the Squad Live-Fire Exercises if I had received prior training on SETS.

sa a m d sd 15. My squad would have performed better on the Squad Live-Fire Exercises if it had received prior training on SETS.

sa a m d sd 16. SETS would be a valuable home-station (armory) device for training infantry skills.

sa a m d sd 17. I enjoyed training with SETS.

18. How would you change SETS to increase its training potential? _____